

Original Research Article

Prevalence and risk factors for type 2 diabetes mellitus in South India

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ABSTRACT

Background: Diabetes mellitus is an iceberg disease. It has reached epidemic proportions globally. According to the World Health Organization, approximately 340 million people have diabetes mellitus worldwide. The prevalence rates have been estimated to be 12% in urban areas and 4% in rural areas. The objectives of the study were to identify the prevalence of type 2 diabetes mellitus in urban field practice area and to study risk factors for type 2 diabetes mellitus in urban field practice area.

Methods: This cross-sectional study was conducted in Mangalore. The study comprised 827 subjects. A pre-tested semi-structured questionnaire was used to collect the data regarding the socio-demographic profile, personal habits, and medical history. Capillary blood glucose estimation was done by using glucometer. Statistical analysis was performed using SPSS version 16.

Results: A total of 827 subjects were participated in the study. The socio-demographic characteristics of the study population showed that 390 (47.2%) were males and 437 (52.8%) were females. The overall prevalence of type 2 diabetes mellitus was 13.5%. Prevalence of diabetes was 15.6% among males and 11.7% among females. The prevalence among overweight and obese was 13.2% and 21.1% respectively. The prevalence among hypertensive subjects was 28.6%. Prevalence of diabetes among smokers was 18.6%. The prevalence of diabetes among alcohol users was 27.2%.

Conclusions: The prevalence of diabetes was slightly higher in comparison to earlier studies. Hence, it is necessary to take steps to implement primary and secondary prevention of diabetes.

Keywords: Hypertension, Obesity, Physical exercise, Prevalence, Risk factors, Type 2 diabetes mellitus

INTRODUCTION

Diabetes mellitus, is an iceberg disease.¹ It has reached epidemic proportions globally.² According to the World Health Organization, approximately 340 million people have diabetes mellitus worldwide.³ Diabetes mellitus is one of the non-communicable diseases which have become a major global health problem. Asia is one of the regions that have high prevalence of diabetes and it is estimated that 20% of current global diabetic population resides in South-East Asia Region.

Diabetes mellitus is gaining momentum in India. Studies have shown the prevalence rate of diabetes mellitus to be 2.4% in rural and 4 to 11% among urban dwellers.⁴ In addition to the undisputed strong genetic predisposition of diabetes mellitus, studies have also revealed the influence of the interaction of host factors like age, sex, family history, obesity and environmental factors like sedentary life style, dietary pattern, socio economic status and habits like alcoholism and smoking.⁵ Identification of these locally relevant and avoidable risk factors will help in primordial prevention of diabetes mellitus. India has

the unfortunate privilege of being the “diabetes capital” of the world; the prevalence rates have been estimated to be 12% in urban areas and 4% in rural areas.⁶ India leads the world with largest number of diabetic subjects earning the dubious distinction of being termed the “diabetes capital of the world”.⁷

Epidemiological studies are urgently needed in each region of India to have a baseline data so that preventive strategies can be planned. There is paucity of such data in the state and the literature review does not reveal many such studies from our area. In view of addressing the demand for this need, the present community based cross sectional study has been undertaken to identify the prevalence of type 2 diabetes mellitus and the risk factors of type 2 diabetes mellitus.

METHODS

This community based cross sectional study was conducted in Kavoar, the urban field practice area of AJ Institute of Medical Sciences, Mangalore. 1035 families have been adopted for health care in 9 areas of Kavoar as urban field practice area with a total population of 4434. The study was conducted from January 2011 to February 2013. All individuals who are of age more than 25 years and residing at Kavoar, the urban field practice area of AJ Institute of Medical Sciences, Mangalore were considered for the study.

For the purpose of study, a pilot study was conducted on 60 subjects to estimate the sample size. The prevalence was found to be 13.33%. Therefore, considering a prevalence of 13.33% with an allowable error of 20% and at 95% confidence interval, the sample size was calculated as: $n = 4pq/d^2$, where, n = estimated sample size, p = prevalence (13.33%), q = 100 - p (86.67%) and d = 20% of p . The estimated sample size for the study was (n) 653. Considering non-response rate of 20%, $20/100 \times 653 = 130$. So, the total sample to be studied, $n = 653 + 130 = 783$. To select the sample for the study, cluster sampling technique was adopted. Five clusters out of 9 were selected with a total population of 904. The selected clusters were Palaneer, Mairodi, Mairodi Gudde, Basavanagar and Kavoar Katte. Complete enumeration of selected clusters was done to arrive at the desired sample size. Hence the study included 904 subjects with a response rate of 91.48%. Hence finally the total sample studied (n) = 827.

The synopsis of the intended study was submitted to the concerned authorities and requisite permission from the institutional medical ethics committee was obtained. Each subject was interviewed individually and the purpose of the study was explained to their understanding. An assurance to the subject about confidentiality of the subject's data was ensured. After obtaining a written consent to participate in the study, each individual was assigned a unique identification number. The pre-tested semi-structured questionnaire was administered and the

information was collected regarding socio demographic profile, past history of non-communicable diseases and personal habits.

Capillary blood was collected by finger prick using disposable lancet and capillary blood glucose concentration was estimated by using glucometer. If random blood glucose level found to have more than or equal to 200 mg/dl fasting blood sugar estimation was done. The diagnosis of type 2 diabetes mellitus was done using WHO criteria for the diagnosis of diabetes mellitus.⁸

Statistical analysis

The data was entered into Excel spreadsheet. Subsequently it was analysed using SPSS version 16. The following statistical methods were employed to analyse the data: i) descriptive statistics: this was used to provide an overview of the socio demographic profile and morbidity profile of study subjects; ii) chi-square test: this test was employed for qualitative data. The test was used to find statistical significance of association between two variables such as diabetes and other risk factors. The statistical significance level was fixed at $p < 0.05$.

RESULTS

In our study, 827 subjects were included. The mean age of the study population was 47.84 ± 14.3 years. The mean age among females was 47.22 ± 14.4 and among males it was 48.54 ± 14.1 .

Table 1: Socio demographic characteristics of study population.

Socio demographic profile		N	%
Age (in years)	25-34	157	19.0
	35-44	207	25.0
	45-54	191	23.1
	55-64	147	17.8
	≥65	125	15.1
Sex	Male	390	47.2
	Female	437	52.8
Religion	Hindu	694	83.9
	Muslim	83	10.0
	Christian	50	6.0
Education status	Illiterate	212	25.6
	primary school	241	29.1
	middle school	188	22.7
	high school	141	17.0
	ITI/diploma	14	1.7
	PUC (12 th std.)	21	2.5
	Degree/postgraduate	10	1.2
Total		827	100.0

From Table 1, 390 (47.2%) were males and 437 (52.8%) were females. 207 (25%) were in age group of 35-44

years followed by 191 (23.1%) in the age group of 45-54 years, and 157 (19%) in the age group of 25-34 years. Maximum 241 (29.1%) had studied up to primary school followed by 188 (22.7%) studied up to middle school. Among the subjects 141 (17%) had studied up to high school. Among the study subjects 212 (25.6%) were illiterate.

Table 2 shows that the overall prevalence of diabetes mellitus among the study population was 13.5%. Out of the 112 subjects, 93 were already diagnosed with diabetes mellitus, and 19 were newly diagnosed during the study.

Table 2: Prevalence of type 2 diabetes mellitus.

Diabetes mellitus	Frequency	Percent
No	715	86.5
Yes	112	13.5
Total	827	100.0

It was observed from Table 3 that highest diabetes prevalence was in the age group of >65 years, that is, 26.4% followed by 25.2% in the age group of 55-64 years, 16.8% in the age group of 45-54 years. Increase in prevalence of diabetes was observed with increase in age ($p<0.001$).

Table 3: Association between socio-demographic characteristics and diabetes mellitus.

Parameters		Diabetes mellitus		Total (%)	P value
		No (%)	Yes (%)		
Age (in years)	25-34	153 (97.5)	4 (2.5)	157 (19.0)	<0.001
	35-44	201 (97.1)	6 (2.9)	207 (25.0)	
	45-54	159 (83.2)	32 (16.8)	191 (23.1)	
	55-64	110 (74.8)	37 (25.2)	147 (17.8)	
	≥ 65	92 (73.6)	33 (26.4)	125 (15.1)	
Sex	Male	329 (84.4)	61 (15.6)	390 (47.2)	0.096
	Female	386 (88.3)	51 (11.7)	437 (52.8)	
Religion	Hindu	597 (86.0)	97 (14.0)	694 (83.9)	0.489
	Muslim	72 (86.7)	11 (13.3)	83 (10.0)	
	Christian	46 (92.0)	4 (8.0)	50 (6.0)	
Education status	Illiterate	180 (84.9)	32 (15.1)	212 (25.6)	0.236
	Primary School	209 (86.7)	32 (13.3)	241 (29.1)	
	Middle School	158 (84.0)	30 (16.0)	188 (22.7)	
	High School	128 (90.8)	13 (9.2)	141 (17.0)	
	ITI/diploma	11 (78.6)	3 (21.4)	14 (1.7)	
	PUC (12 th std.)	21 (100.0)	0 (0.0)	21 (2.5)	
	Degree/postgraduate	8(80.0)	2 (20.0)	10 (1.2)	

From Table 4, 104 (12.6%) among study population had positive family history of diabetes. Prevalence of diabetes was 32.7% among those who had family history of diabetes mellitus and 10.8% among those who did not. Family history of diabetes mellitus had highly significant association with prevalence of diabetes mellitus ($p<0.001$). Among the study population 174 (23.5%) were consuming organ meat. The prevalence of diabetes among those consuming organ meat was 24.1% and 10.9% among those who were not consuming organ meat. The statistical test showed that consumption of organ meat had highly significant association with prevalence of diabetes mellitus ($p<0.001$). 274 subjects were consuming tobacco and 553 were not. The prevalence of tobacco consumption was 33.1%.

173 subjects were consuming alcohol and 654 were not. The prevalence of alcohol consumption was 20.9%. The prevalence of diabetes among alcohol consumers was 27.2% whereas it was 9.9% among those who were not consuming alcohol and the same was found to be statistically very highly significant ($p<0.001$). The prevalence of hypertension among the study population was 30.8%. It can be observed that 175 (21.2%) subjects were obese and 190 (23%) were overweight. Those with normal body mass index (BMI) and underweight were 43.2% and 12.7% respectively. The prevalence of diabetes among obese was 21.1% and among overweight was 13.2%. Prevalence of diabetes increased with increase in BMI. Also, chi-square test showed significant association between BMI and prevalence of diabetes mellitus ($p=0.009$).

Table 4: Association between risk factors and diabetes mellitus.

Parameters		Diabetes mellitus		Total (%)	P value
		No (%)	Yes (%)		
Family history	Absent	645 (89.2)	78 (10.8)	723 (87.4)	<0.001
	Present	70 (67.3)	34 (32.7)	104 (12.6)	
Type of diet	Vegetarian	77 (96.6)	8 (9.4)	85 (10.3)	0.240
	Mixed	638 (86.0)	104 (14.0)	742 (89.7)	
Consumption of organ meat	No	506 (89.1)	62 (10.9)	568 (76.5)	<0.001
	Yes	132 (75.9)	42 (24.1)	174 (23.5)	
Tobacco consumption	No	492 (89.0)	61 (11.0)	553 (66.9)	0.003
	Yes	223 (81.4)	51 (18.6)	274 (33.1)	
Consumption of alcohol	No	589 (90.1)	65 (9.9)	654 (79.1)	<0.001
	Yes	126 (72.9)	47 (27.2)	173 (20.9)	
Physical activity	Vigorous exercise	137 (97.2)	4 (2.8)	141 (17.0)	<0.001
	Moderate exercise	55 (85.4)	88 (14.6)	603 (72.9)	
	Sedentary exercise	63 (75.9)	20 (24.1)	83 (10.0)	
Blood pressure	Normal	533 (93.2)	39 (6.8)	572 (69.2)	< 0.001
	Hypertension	182 (71.4)	73 (28.6)	255 (30.8)	
Body mass index	Underweight (<18.5)	94 (89.5)	11 (10.5)	105 (12.7)	0.009
	Normal (18.5-22.9)	318 (89.1)	39 (10.9)	357 (43.2)	
	Overweight (23-24.9)	165 (86.8)	25 (13.2)	190 (23.0)	
	Obese (≥25)	138 (78.9)	37 (21.1)	175 (21.2)	

DISCUSSION

The overall prevalence of diabetes mellitus among the study population was 13.5%. A study conducted by Rao et al at Udupi on the prevalence of type 2 diabetes mellitus showed the overall prevalence of diabetes mellitus of 16%.⁹ Similar study was conducted by Vijayakumar et al in Kerala and the prevalence of diabetes mellitus was 14.6%.¹⁰ The National Urban Diabetes Survey (NUDS), a population-based study, reported that the prevalence of type 2 diabetes mellitus in Bangalore as 12.1%.¹¹

A study conducted by Rao et al at Udupi showed that increase in age was directly proportional to the prevalence of diabetes mellitus. The Chi-square for trend showed significant association between increasing age and diabetes mellitus.⁹ Similar study was conducted by Vijayakumar et al showed that prevalence in the 18-29 years age group was 0.7%, 30-44 years was 7.7%, 45-59 years was 29.6%, 60 years and above was 28.2%.¹⁰ Patil et al in Dharwad showed that as age increased the prevalence of diabetes mellitus increased.¹² Mohan et al in Chennai found that the prevalence of diabetes at age <30 years was 0.6%, at age 31-40 years: 4.8%, at 41-50 years: 15.2%, at 51-60 years: 22.9%, at 61-70 years: 34.2% and in those >70 years of age, 22.4% had diabetes.¹³

The prevalence of diabetes among males was 15.6% and among females was 11.7%. Apparently, higher prevalence was seen in males. However, the same is not statistically significant (P=0.096). Rao et al showed that

18.8% of the males and 14.4% females had diabetes mellitus.⁹ Similar study was conducted by Vijayakumar et al with 16.5% among males and 13.5% among females had diabetes mellitus.¹⁰

According to Rao et al positive family history of diabetes mellitus was present in 26% of the individuals.⁹ According to Vijayakumar et al the prevalence of diabetes mellitus among those with family history of diabetes mellitus was 24.2% compared to 11.7% among those without.¹⁰ Dhadwal et al also found that family history was present in 34.5% of diabetics and was significantly associated with diabetes (p<0.01).¹⁴ Majgi et al showed that family history of diabetes was positive in 9.3% of the subjects.¹⁵ Gupta et al showed that 11.42% of the respondents had family history of diabetes mellitus.¹⁶

The prevalence of tobacco consumption was 33.1%. Similar study showed prevalence of tobacco consumption in 30.6% of the subjects.¹⁰ According to Patil et al the prevalence of tobacco consumption was 29.8%.¹² In our study the prevalence of diabetes among tobacco consumers was 18.6% whereas it was 11% among those who were not consuming tobacco. The same was found to be statistically significant (p=0.003). Vaz et al found that smokers had a higher chance of having diabetes (36.5%) compared with nonsmokers (5.5%).¹⁷

The prevalence of diabetes among alcohol consumers was 27.2% whereas it was 9.9% among those who were not consuming alcohol and the same was found to be statistically very highly significant (p<0.001). Similarly

Dutt et al in his study identified that alcohol consumption is a risk factor for diabetes ($p<0.001$).¹⁸ Kokiwar et al also found that the prevalence of diabetes was high in those consuming alcohol (22.29%) as compared to non-alcoholics i.e. 11.46% ($p<0.001$).¹⁹ 141 (17%) subjects performed vigorous exercise, 603 (72.9%) performed moderate exercise and 83 (10%) were sedentary, considering both physical exercise and occupation. Patil et al showed that the prevalence of type 2 diabetes mellitus among sedentary subjects was 26.08%.¹² Majgi et al showed the prevalence of diabetes mellitus among those who did vigorous exercise was 3.1%.¹⁵

The prevalence of hypertension among the study population was 30.8%. Similar study was conducted by Vijayakumar et al showed the prevalence of hypertension was 36.1%.¹⁰ The prevalence of diabetes mellitus was 28.6% among hypertensives and 6.8% among normotensive population. It was found that blood pressure is significantly associated with prevalence of diabetes mellitus ($p<0.001$). Similar study showed the prevalence of diabetes mellitus among hypertensives was 25.9%.¹⁰ Similar observation was also made by Acemoglu et al that type 2 diabetes mellitus was more frequent among people with hypertension than with normotension and also was significantly associated ($p<0.001$). According to regression analysis, diabetes mellitus was 2 times higher in hypertensives than in normotensives.²⁰

The prevalence of diabetes among obese was 21.1% and among overweight was 13.2%. Prevalence of diabetes increased with increase in BMI. Vijayakumar et al showed the prevalence of diabetes mellitus among obese and overweight was 21.4% and 18.7% respectively. The data showed that increase in BMI increased the prevalence of diabetes mellitus.¹⁰ Majgi et al showed that the prevalence of diabetes mellitus among overweight and obese subjects was 10.9% and 15.7% respectively.¹⁵ Similarly, in a study done by Kokiwar et al it was observed that abnormal glucose tolerance was significantly higher in those with BMI 25 kg/m^2 (27.47%) as compared to those having BMI $<25 \text{ kg/m}^2$ (9.7%) ($p<0.001$).¹⁹

The limitations of the study include efforts were taken to include many of hypothetical risk factors before the start of the study, but due to feasibility and practical reasons we studied a few risk factors.

CONCLUSION

Thus, the study showed significant association between increasing age, family history of diabetes, consumption of organ meat, tobacco consumption, alcohol consumption, physical activity, hypertension and BMI. Prevention of diabetes mellitus is possible by modifying the factors influencing diabetogenesis such as obesity, diet and physical activity. Long-term studies have shown that beneficial effects of lifestyle modifications on reducing the risk of diabetes. India is going to face big challenge

posed by the prevalence of diabetes and its complications unless steps are taken to implement the primary and secondary prevention of diabetes. Hence it is necessary to identify the risk factors for type 2 diabetes mellitus in order to prevent it at the earliest.

Recommendations

General population should be made aware of high risk factors and complications of diabetes mellitus. Behavioural change communication to adopt healthy lifestyle by modifying modifiable risk factors such as avoiding sedentary behaviour, increasing physical activity, dietary modification- low fat, minimal consumption of junk foods and organ meat and voluntary weight losing. As hypertension is a risk factor for type-2 diabetes mellitus, known cases of hypertensives should monitor their blood sugar level regularly. Health care providers should develop diabetic clinics to provide services regarding general examination, nutrition advice, physical exercise, foot care, de-addiction and other health concerns in order to control and prevent diabetes mellitus.

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